Northwestern Ontario Boreal Forest Management

Northwestern Ontario Forest Technology Development Unit

Technical Notes

TN-11 1992

BARTT MARK IV AND TTS SIGMA PRECISION SEEDERS

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INTRODUCTION

The Bartt Mark IV Seeder and the TTS Sigma Seeder are two new precision seeding devices designed to singularize tree seed and to deliver it at prescribed intervals during site preparation by a furrow type scarifier. This method of ground seeding offers an opportunity to regulate the number of seeds sown per hectare and to ensure that the seeds are placed at the most desirable microsite in the furrow. The precision seeders are made accurate with the use of a computerized monitor that regulates seed dispersal to match the forward ground speed of the skidder.

When compared with aerial seeding this method offers the following advantages:

- reduction of the number of seed required per hectare,
- opportunity to use genetically improved seed,
- precision seeding within and between rows,
- reduced stem densities, and decreased clustering,
- reduced future stand thinning costs.

The Bartt Tree Seeder was designed and manufactured in Concord Ontario by Bartt Forestry Equipment Ltd. It uses an agricultural singulation unit that is manufactured by Gaspardo, an Italian company (Figure 1). The seeder has undergone some improvements in the past three years and is now operational. Trials have been conducted in Maine (U.S.A.), Kenora, Ignace and now Dryden (Ont.).

The TTS Sigma seeder was designed and manufactured in Finland by Tyotehoseura Forest Improvement Machines Company (Figure 2). The seeder used in the Dryden trials is the first from this manufacturer to be used in North America.

The Ministry of Natural Resources, Northwest Region purchased one of each of these seeders in the spring of 1991. Dryden District undertook a trial to evaluate each seeders' performance and maintenance requirements under similar site conditions. Unfortunately the seeders arrived later in the season than expected and only 150 hectares were scarified and seeded. Despite some initial trouble with the speed sensors for each seeder, once they were "up and running" both proved quite reliable. The seeds were normally applied at a spacing of 30 cm within the row with the TTS Delta Disc Trenchers set at 2 metres apart (yielding a rate of 16,666 seeds per hectare).

The purpose of this technical note is to describe the Bartt and TTS Sigma seeders and to summarize the results and problems encountered in trials by Dryden district for the benefit of others intending to use the equipment.

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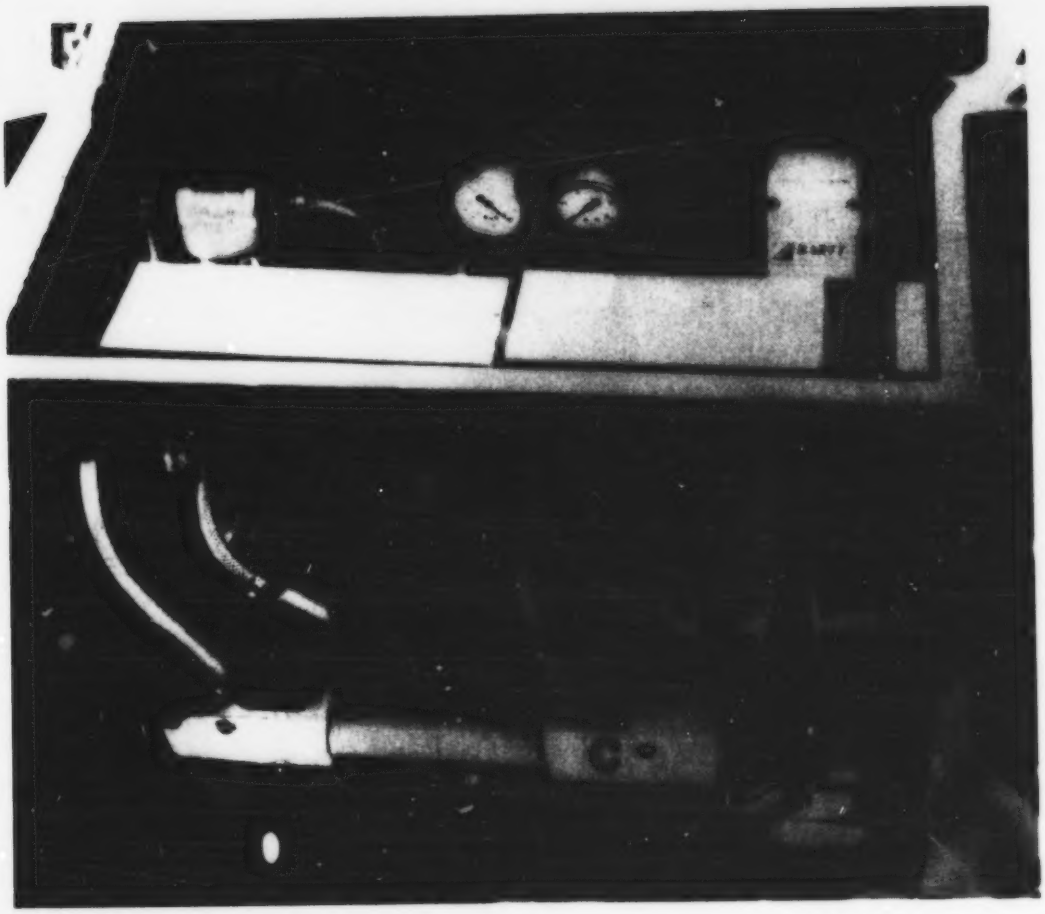

Figure 1. The Bartt Seeder

Tree seed is poured into the two seed hoppers (A). The Gaspardo Seeder Units (B) then pick up the seed from the hoppers, singulate the seed and deliver one or two seeds at a time to a venturi (C). The Gaspardo seeder singulates seed using vacuum pressure and a round, rotating stainless steel disc which has 20 to 40 holes evenly spaced around the outside edge. The vacuum, when applied on the opposite side of the disc from the seed hopper, causes the individual seed to cling to the disc. The disc continually turns, picking up more seeds. The seed rotates with the disc until, at the lowest part of the revolution, the vacuum is released and the seed falls down into the venturi. The seed is pushed out from the venturi through the seed delivery tube (D) by air pressure. As the seed travels through the hose, it passes through a seed counter which in turn sends a message to the monitor to count the seed and indicate successful operations. The rate of seed delivery (and thus the spacing of the seed) is controlled by the on-board computer monitor which relates forward ground speed, as measured by a speed sensor at the drive shaft, to the rpm of an electric motor driving the Gaspardo Seeder Units.

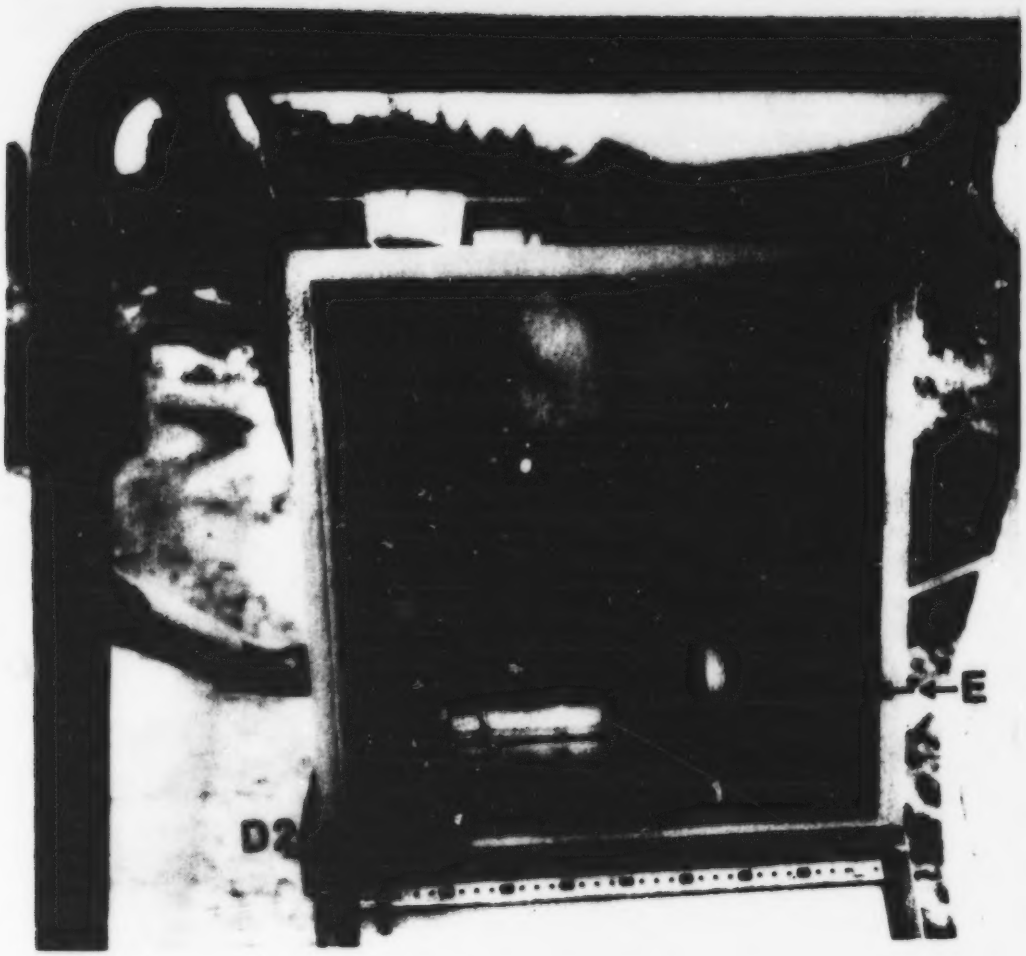

Figure 2. The TTS Sigma Seeder

Tree seed is poured into the seed hopper (A). The seed then enters into one of two auger screw compartments (B). The augers turn very slowly by small electrical motors (C), dropping seed downwards past a photo cell (located at D1). In this photograph, the photo cell (D2) has been removed and placed on the bottom of the seeder for cleaning. The photo cell sends a message to the monitor to indicate successful operations. An air blower (E) then pushes the seed from the photo cell area through the seed delivery tube out to the trencher location. The frequency of seed dispersal is controlled by the speed of the augers and motors which in turn are controlled by the seed monitor, the prescribed spacing and the ground speed as measured by a speed sensor mounted at the drive shaft yoke.

INSTALLATION PROCEDURE

As both of these seeders have very similar requirements for installation, only a generic discussion of the procedure will be offered here. The Bartt Seeder was installed on a 1985 Timberjack skidder and the TTS Sigma was installed on a 1985 Clark skidder. Both these skidders were equipped with a TTS Delta Trencher.

Installation of the Seeder's Main Unit and Electrical Wiring

The main unit should be installed where it can be easily serviced. This will usually be between the cab and the winch arch (see Figures 3 and 4). Installation will require 1 to 2 days, preferably indoors at a shop which can undertake any welding and fabrication work required. Most of the wire connections for both seeders are made simple by the use of quick connect male-female plugs of various types or by solder-less wire connectors.

Recommendations:

- limit the exposure of the unit and its wiring harness' to sources of heat such as the winch drum and the hydraulic oil tanks and lines,

- install a surrounding protective cover over the unit to ensure it cannot be damaged from any logging debris from below or from trees that may fall onto it. The protective covers shown in Figures 3 and 4 proved inadequate for normal site conditions.

- ensure that the unit can be easily removed for repairs or replacement,

- connect the power supply wires from the battery to the main unit, ensure there is a 30 amp fuse on the positive power connection near the battery to protect the seeder's main unit,

- test your proposed skidder well enough ahead of the installation date to ensure you will be guaranteed a continuous output of 12 volts (+/- 2) and 32 amps under all conditions of operation. Some of the places to check for correct electrical output include: alternator, battery, and trencher control panel. Be prepared to make modifications, repairs or substitution of complete skidder if you cannot achieve the correct electrical requirements of the seeder before undertaking installation.

Installation of the Seed Monitor

The seed monitor is usually installed on the wire cage of the skidder cab where it will be close to the power source from the battery and close to the control panel for the trencher.

Recommendations:

- while the seed monitors have slow blow fuses for their individual protection ensure you have 2 or 3 sets of replacement fuses as they can be difficult to find when needed,

- ensure that the trencher control panel is fully operational and that you have replacement fuses,

- ensure a good electrical connection at the trencher control box, it is usually made on the down pressure control switch using a wire terminal clip.

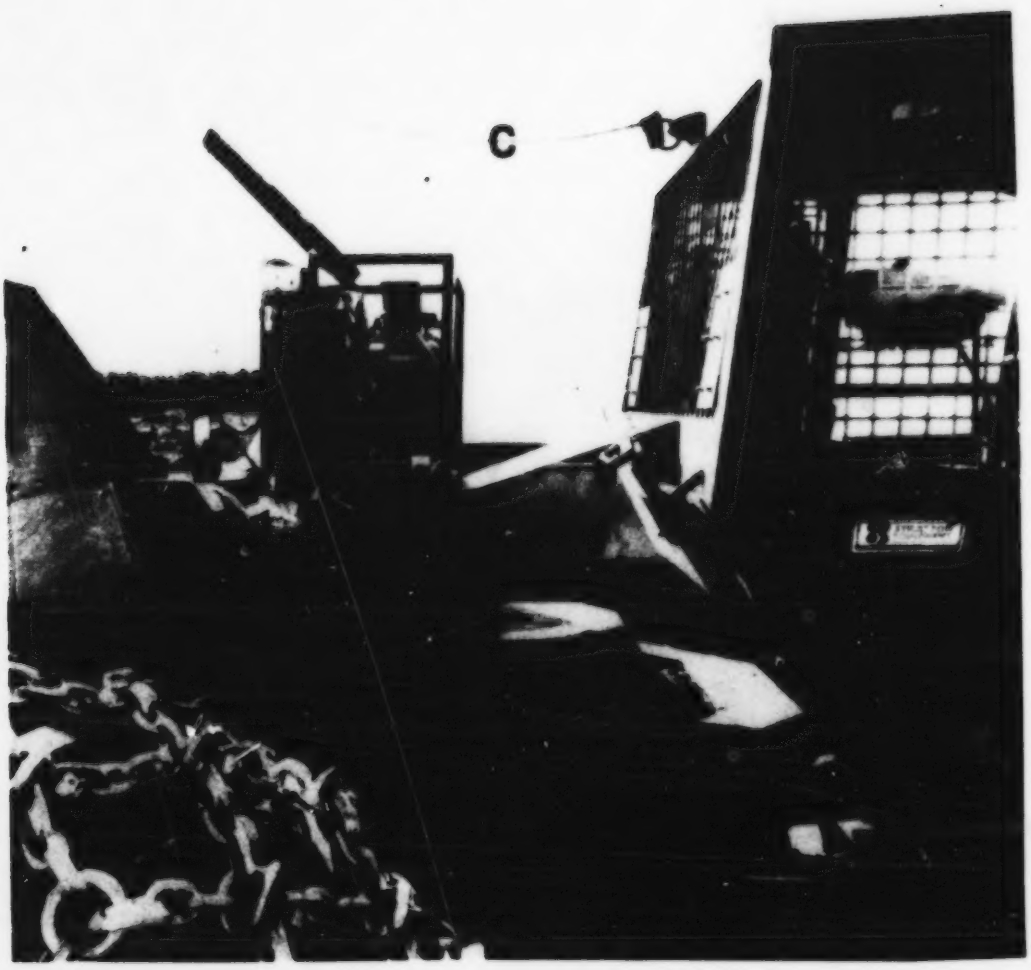

Figure 3. Bartt Seeder Installation

The seeder (A) was installed over the skidder's winch drum which was not in use at the time. The seeder was bolted to a frame (B) made from tubular and angle iron which in turn was bolted to the skidder for easy removal. A steel protective cover can be fabricated and installed to protect the seeder from overhead or side damage. The steel cable (C) proved inadequate protection. The two seed delivery hoses and seed counter wires (D) came through the bottom corner of the seeder passing underneath the frame (B) and over the hydraulic oil tank cover (E).

Figure 4. TTS Seeder Installation

The seeder (A) was installed onto a frame welded on the fairlead arch as use of the winch was required for this skidder. A tubular steel protective cover (B) for the seeder was bolted on to the skidder frame. The seed delivery hose (C) passed down through the fairlead arch to a steel tube welded onto the trencher arms (D). The seed delivery hose was covered with a spiral plastic hose wrap (E) where it was exposed. Round tubular steel (F) was then used to align the hose and ensure precise aim of the seed onto the furrow. The end of the hose was held in place by hose clamps or plastic tie wraps.

Installation of the Speed Sensor

A speed sensor is installed to measure the frequency of the drive shaft revolutions and to send that information to the seed monitor where it is processed to indicate forward ground speed. The speed sensor is installed so that it can be pointed at a metal sensor block mounted on the drive shaft yoke. Careful installation is important as the speed sensors in both seeders caused the most frustration and effort during this trial.

Recommendations:

- as the sensor must be within 3-5 mm of the drive shaft yoke block, a rigid and sturdy steel bracket must be welded or bolted in place to hold the sensor,

- the sensor must be in a relatively accessible location to facilitate easy adjustment and replacement, but there should be no chance of damage from logging debris,

- the sensor wire must be protected from heat and other potential damage as it travels through the pivotal point on the skidder to the monitor (Sigma) or the main unit (Bartt).

Installation of the Seed Delivery Hoses

Two anti-static seed delivery hoses travel from the main unit through the winch arch, down to the trencher's main body arms and along the arms to the horizontal plate at the bottom of the vertical spindle body (see Figure 5). As the hoses are put in a location where they are at considerable risk of damage, careful attention must be paid to their protection.

Recommendations:

- when attaching the hoses to the various components, ensure the ends of the hoses are reamed out to the wire braid to maintain the anti-static properties required,

- wrap the hose and seed counter wire (Bartt) in Imperial Eastman 90232516 Urethane Guard Hose Wrap 1 from the main unit to the trencher arms. This product proved more durable than the metal spiral hose wrap which was collapsed by logging debris,

- cover the hose and wire along the trencher arms with square or round tubular steel to protect it from logging slash kicked up from the discs (as the Bartt seeder has a seed counter at this location, ensure the tubing is large enough to cover the counter),

- use square or tubular steel (tack welded) to align the seed delivery hose as it passes from the trencher arms to the vertical spindle body and to the horizontal plate above the disc. At the final tube attach a small rod to the tube so that a hose clamp can be used to immobilize the seed delivery hose,

- then, adjust the tack weld and tube until you have achieved precise aim of the seed onto the furrow while the skidder and disc trencher are in full operation. You can use a hard hat to observe the seed landing in the furrow.

- ensure you have cemented all welds before leaving the shop area.

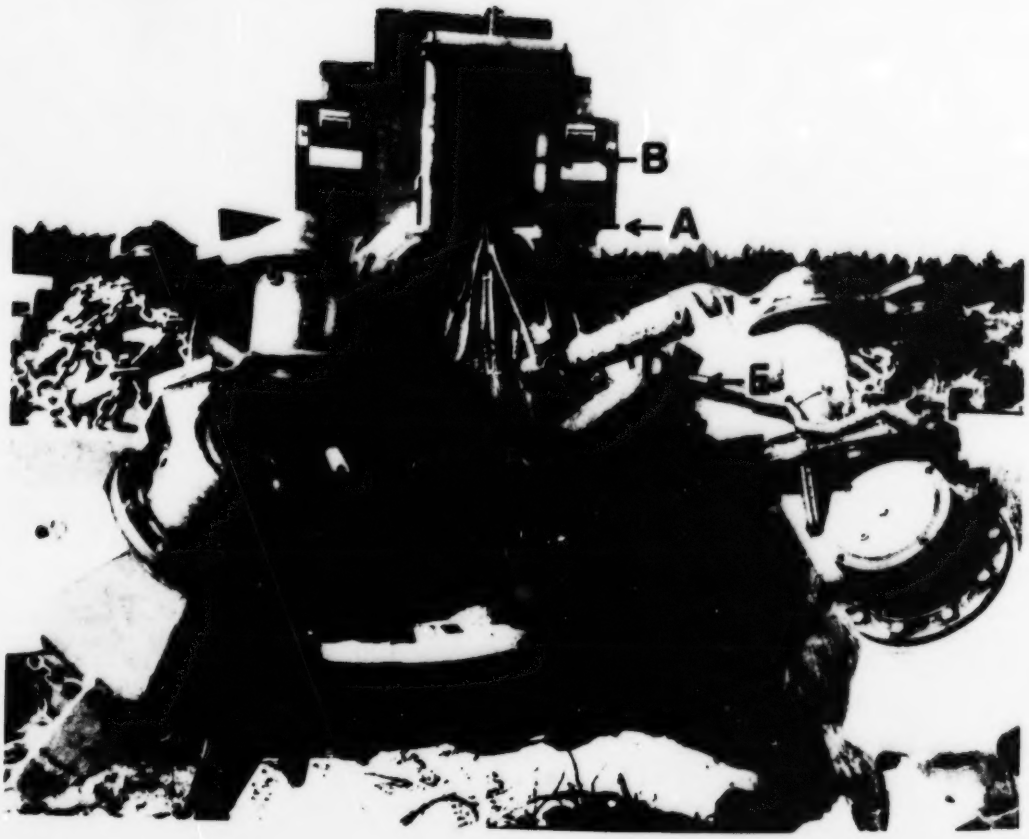

Figure 5. Bartt Seed Delivery Hose Installation

The two seed hoses and seed counter wires (A) were brought together over the hydraulic oil tank, fed underneath the winch roller (B) and down to the trencher arms (C). A steel tube (D) was bolted onto the trencher arms to protect the seed delivery hose, the seed sensor and its wiring. The seed delivery hose was covered with a spiral wire wrap (E) where it was exposed. Round tubular steel (F) was then used to align the hose and ensure precise aim of the seed onto the furrow. The end of the hose was held in place by hose clamps or plastic tie wraps.

CALIBRATING THE FREQUENCY OF SEED DELIVERY

Calibrating the Bartt Seeder

The computer monitor which controls the seed dispersal frequency requires the following inputs: a measure (cm) of the circumference of the skidder tire, seed spacing rate (cm) within the furrow, and the spacing rate (m) between furrows. Once this data is input, you can begin seeding.

Verify the accuracy of the seeder's frequency of seed delivery by attaching a seed collection bag to each of the seed delivery tubes and scarify 100 m. Count the number of seeds collected over that distance to check if the seed bag count equals the seed count recorded by the computer monitor. In our trials the physical seed count usually was within 5% of what the seed monitor recorded. A seed collection bag can be made from aluminum window screening.

At this time you can also verify the speed sensor accuracy by measuring the travel time of the skidder for 100 m.

Calibrating the Sigma Seeder

The Sigma Seeder's monitor does not count the number of individual seeds delivered, so the only way to calibrate the unit for seed spacing is through progressive trials. Normally you scarify a measured distance of 100 m collecting the seed in a seed bag. Adjust the seeding rate by changing the size of the auger screws or by adjusting the "fine tuning" knobs on the seed monitor until you have achieved the desired seeding rate.

MAINTENANCE AND TROUBLE SHOOTING

Maintenance

As with all mechanical equipment, a good maintenance program will reduce the frequency of failures and break downs. Both seeders should be cleaned and checked once a day when they are fully operational. Normally 20 to 30 minutes per seeder unit is required to complete the maintenance, visually check all the parts and add seed to the hoppers.

Trouble Shooting

The seed monitor for both seeders will signal when and where there is a seeding failure. The failures could result from loss of seed in the hopper, a failure of the Gaspardo Seed Singulator in the Bartt, a dirty photo cell in the Sigma, or electrical wires or hoses damaged from logging debris. If spare parts are available on site, most repairs can be made in 30 minutes to 2 hours.

A spare parts kit on site might include:

- seed delivery hose, hose clamps and protective covering,
- speed sensor and its wiring,
- electrical wiring, assorted fuses, terminal clips, solder less connectors and electrical tape,
- tool box complete with a multi-meter to check for shorted or broken wires.

Table1. Bartt Mark IV Seeder Operations Summary

DAY	# HA. SCARIFIED	# HRS. * STANDBY	SEEDER OPERATIONS
1 - 4	0	40	installation
5	3.5	1	calibration, skidder down
6-12	15.0	41	seeder failure -trouble shooting
13	10.5	0	seeder turned off
14	8.8	3	install new speed sensor
15	9.6	0	full operation
16	9.9	0	full operation
17-24	0	0	fire-shutdown and skidder repair
25	6.4	1	fuse blown
26	9.6	0	full operation
27	11.9	0	full operation
28	6.0	0	full operation
29	6.9	0	full operation
30	9.6	5	replace seed delivery hose
31	12.8	0	full operation
32	8.0	0	full operation
33	5.3	4	remove seeder

* as required for seeder installation or repairs.

Table 2. TTS Sigma Seeder Operations Summary

DAY	# HA. SCARIFIED	# HRS. * STANDBY	COMMENTS
1	0	10	installation
2	0	10	installation, speed sensor damaged during calibration
3-5	0	30	no speed sensor available
6	0	10	install new speed sensor
7	4	7	speed sensor damaged again
8	0	10	no speed sensor available
9	3.6	5	fabricate and install new sensor mount
10	11.6	0	full operation
11	7.6	0	trencher down
12-13	0	0	trencher down
14	8.1	0	full operation
15	3.0	0	skidder down

* as required for seeder installation or repairs.

CONCLUSIONS

Once the seeders were fully operational and the new speed sensors installed, both performed very well. The frequency of seed delivery was checked on a regular basis and both seeders proved to be very accurate. Slash accumulating around the trencher discs and blocking the passage of seed from the delivery tube to exposed mineral soil might limit seeding success. Seed delivery and aim into the mid-slope of the furrow appeared to be maintained throughout the trial. Only when the disc encountered stumps or rocks causing violent movement of the trencher arms was seed directed away from the furrow. No physical damage to the seed was observed from either seeder.

Each seeder has advantages. The Bartt seeder has a seed counter and can measure daily production (ie. hectares seeded) but also has more mechanical parts and thus is more complex. Both have the advantages associated with the use of trencher type site preparation equipment with the added benefit of one step regeneration.

It is too early to rank one seeder over another. For the time being, both seeders should continue to be tested under similar site conditions until a data base has been accumulated for comparison and the results of germination counts and location can be observed. There was substantial standby time for each seeder required to trouble shoot unusual problems that were finally related to the speed sensors. The speed sensor unit for the Bartt Mark IV Seeder was defective in manufacture, but once this problem was corrected, the seeder ran very well. The speed sensor unit for the TTS Sigma Seeder was continually damaged when installed according to the instructions provided. When the sensor was moved from the drive shaft to the drive shaft yoke, the seeder ran very well.

Tables 1 and 2 give some indication of the daily production of each seeder. Note in some cases there was down time due to mechanical problems with the skidder or the trenchers and because of fire restrictions. Further trials are necessary to determine potential productivity.

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